

(19)



(11)

**EP 2 801 956 B1**

(12)

**EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:  
**11.07.2018 Bulletin 2018/28**

(51) Int Cl.:  
**G07C 9/00 (2006.01) B61L 27/00 (2006.01)**  
**G06K 9/00 (2006.01)**

(21) Application number: **14001584.3**

(22) Date of filing: **06.05.2014**

(54) **Passenger counter**

Passagierzählvorrichtung

Dispositif de comptage de passagers

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB  
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO  
PL PT RO RS SE SI SK SM TR**

(30) Priority: **10.05.2013 JP 2013100305**

(43) Date of publication of application:  
**12.11.2014 Bulletin 2014/46**

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## Description

### BACKGROUND OF THE INVENTION

#### Field of the Invention

**[0001]** The present invention relates to a passenger counter for counting the number of passengers who get in and out of a vehicle, such as a bus, a train, and an elevator.

#### Description of the Related Art

**[0002]** Conventionally, there is known a passenger discrimination/detection device which is provided in, e.g., a bus so as to discriminate/detect getting-on and getting-off of passengers (Patent Application Publication No. JP 2011-242901). The passenger discrimination/detection device has a first photoelectric sensor and a second photoelectric sensor. The first and second photoelectric sensors are provided in a getting-on/off passage around an inside of a platform and arranged in the mentioned order from a near side of the platform. The first and second photoelectric sensors are disposed such that optical paths thereof are both interrupted by passengers passing through the getting-on/off passage. A state where the optical paths of both first and second photoelectric sensors are not interrupted is referred to as "state 0", a state where the optical path of only the first photoelectric sensor is interrupted is as "state 1", a state where the optical paths of both first and second photoelectric sensors are interrupted is as "state 2", and a state where the optical path of only the second photoelectric sensor is interrupted is as "state 3". When the first and second photoelectric sensors transit in the order of "state 1", "state 2", "state 3", and "state 0", the passenger discrimination/detection device discriminates that a passenger gets on a vehicle such as a bus and adds 1 to the number of getting-on passengers; on the other hand, when the first and second photoelectric sensors transit in the order of "state 3", "state 2", "state 1", and "state 0", the passenger discrimination/detection device discriminates that a passenger gets off the vehicle and adds 1 to the number of getting-off passengers.

**[0003]** Further, a method for counting people passing through a gate is known from US 2008/0212099 A1. A color video camera is set on the ceiling with a view of facing vertically downward above the passersby. Two base-lines within a surveillance area are virtually defined for direction orienting of entering or leaving the gate. The counting process will be started and ended when one people-image moves across the entering base-line and leaving base-line, respectively. Then, the in-counting and out-counting will be verified when the people have crossed over the leaving base-line and entering base-line, respectively.

**[0004]** WO2012/110653 discloses a method for detecting people in a surveillance area in a vehicle, the sur-

veillance area comprising an inner area surrounded by an outer area that is partly outside the vehicle.

### SUMMARY OF THE INVENTION

**[0005]** It can be considered that, in such a conventional passenger discrimination/detection device, when a passenger who moves around the platform in a state where a platform door is closed to disable getting-on/off, he or she is erroneously counted. Further, it can be considered that when a passenger who gets on the bus at a bus stop and stays around the platform or has no choice but to stay around the platform due to congestion, the first and second photoelectric sensors do not transit according to the prescribed order, with the result that he or she is not counted. Thus, the number of passengers cannot be counted accurately for each location, such as a station, at which the passengers get on and off the vehicle.

**[0006]** The present invention has been made in view of the above situation, and an object thereof is to provide a passenger counter capable of accurately counting the number of passengers.

**[0007]** There is provided according to the present invention a passenger counter according to independent claim 1. With the claimed configuration, it is possible to discriminate between a getting-on passenger and a getting-off passenger. That is, a person who moves from an outer area outside the vehicle to an outer area inside the vehicle through the inner area is regarded as the getting-on passenger, and a person who moves from the outer area inside the vehicle to outer area outside the vehicle through the inner area is regarded as the getting-off passenger. The discrimination between the getting-on passenger and getting-off passenger can be made irrespective of whether an entrance and an exit are integrated in one or separated. Thus, the person who gets off the vehicle from the entrance or a person who gets on the vehicle from the exit can also be counted on the basis of a getting-on/off direction. Further, by setting the inner area, it is possible to prevent multiple counting which may occur due to walking around the platform or movement of a person's body in an anteroposterior direction due to swaying movement of the vehicle.

**[0008]** Further, the count determination unit does not count the number of persons while the door is closed, so that even when a person moves around the platform while the door is closed, he or she is not erroneously counted.

**[0009]** Further, the count determination unit determines, as a person to be counted, a person existing in the inner area at a time when the door is closed or opened. Even when a person stays around the platform at a time when the opened door is closed or the closed door is opened, (specifically, in a case where the opened door is closed when a person who has got on the bus cannot move inside the vehicle due to congestion), he or she can be counted in the number of getting-on passengers. Further, in a case where a person staying around the platform gets off the vehicle from the platform

when the closed door is opened, he or she can be counted in the number of getting-off passengers. In the claimed invention, the count determination unit counts, as the number of getting-on passengers, the number of persons who move from the outer area outside the vehicle to the outer area inside the vehicle through the inner area while the door is opened and further counts, as the number of getting-on passengers, the number of persons who move from the outer area outside the vehicle to the inner area among the persons who stay in the inner area at a time when the opened door is closed.

**[0010]** With this configuration, a person who gets on the vehicle when the door is opened and stays around the platform even after the opened door is closed can be counted in the number of getting-on passengers. Further, it is possible to prevent a person who has stayed around the platform from being counted again. Furthermore, the count determination unit of the claimed invention counts, as the number of getting-off passengers, the number of persons who move from the outer area inside the vehicle to the outer area outside the vehicle through the inner area while the door is opened and further counts, as the number of getting-off passengers, the number of persons who move from the inner area to the outer area outside the vehicle among the persons who stay in the inner area at a time when the closed door is opened.

**[0011]** Since the count processing is not performed while the door is closed, it can be considered that a condition of the movement path from the outer area inside the vehicle through the inner area to the outer area outside the vehicle is not satisfied for a getting-off passenger who walks around the platform and gets off the vehicle when the door is opened. For example, at night, the vehicle runs with illumination for illuminating the platform turned off, so that even when a person to get off the vehicle comes close to the door, he or she cannot be recognized. Then, when the person recognized at a time when the illumination is turned on and the door of the platform is opened exists in the inner area, the above condition is not satisfied.

**[0012]** Thus, in the above configuration, the persons who move from the inner area to the outer area outside the vehicle among the persons who stay in the inner area at a time when the closed door is opened are counted in the number of getting-off passengers, so that even a person who has not passed through the inside of the vehicle immediately before he or she stays around the platform and thereafter gets off the vehicle when the door is opened can be counted in the number of getting-off passengers.

**[0013]** The passenger counter may further include a door state recognition unit configured to recognize a state of the door through a door open/close operation signal for opening/closing the door, a door open/close detection signal for directly detecting an open/close state of the door, or image recognition of a motion of the door on the captured image.

**[0014]** With this configuration, it is possible to reliably

recognize a state of the door (door open state, door close state, at a time when the opened door is closed, and at a time when the closed door is opened, and so on). In particular, the passenger counter of the present invention is provided with the imaging section for person recognition, so that when a motion of the door is recognized on the captured image, it is possible to omit a special configuration for obtaining an external signal to recognize the state of the door, thereby eliminating the need for wiring and connection work for taking in the external signal.

**[0015]** Preferably, the passenger counter further includes: a person recognition unit configured to recognize a person on the captured image by identifying the person with a unique point; and a tracking unit configured to track the unique point to track the person on the captured image, wherein the setting unit sets the inner area in a range including the unique point of the person on a passage of the platform inside the vehicle.

**[0016]** With this configuration, it is possible to reliably recognize a person staying around the platform.

**[0017]** According to the present invention, even in a situation where a person stays around the platform, the number of passengers can be accurately counted for each location, such as a station.

## BRIEF DESCRIPTION OF THE DRAWINGS

### **[0018]**

[Fig. 1]

Fig. 1 is a schematic view of an inside of a bus in which a passenger counter according to an embodiment of the present invention is installed;

[Fig. 2]

Fig. 2 is a block diagram illustrating a configuration of the passenger counter according to the embodiment;

[Fig. 3]

Fig. 3 is a schematic view illustrating an inner area and an outer area on a captured image;

[Fig. 4]

Fig. 4 is an explanatory view of data content stored in person area position data section;

[Fig. 5]

Fig. 5 is a flowchart for performing count processing at an entrance;

[Fig. 6]

Fig. 6 is a flowchart for performing count processing at an exit; and

[Fig. 7]

Fig. 7 is a flowchart for performing count processing at a platform;

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

**[0019]** Hereinafter, an embodiment of the present in-

vention will be described with reference to the drawings.

**[0020]** Although the present embodiment is applied to a bus, the present invention is not limited to this, but can be equally applicable to various vehicles, such as a train or an elevator, having an opening/closing door at a platform or an entrance.

**[0021]** As illustrated in Fig. 1, a passenger counter 1 of the embodiment is provided in a bus and includes an imaging section 2 and a processing section 3.

**[0022]** The imaging section 2 is composed of a CCD camera or the like. The imaging section 2 is communicably connected to the processing section 3 by a communication cable, and the like. Imaging data corresponding to an image captured by the imaging section 2 is transmitted to the processing section 3. The imaging section 2 may be communicably connected to the processing section 3 by wireless. In the present embodiment, an entrance 5 and an exit 6 are located at a front side and a rear side of the bus, respectively, as the platform, and the imaging section 2 is provided at both the entrance 5 and exit 6. An imaging section 2A provided at the entrance 5 is composed of a single CCD camera or the like, installed at a ceiling around the entrance 5, and captures an area including the entrance 5 from the upper portion. The imaging section 2A is installed such that the entire lower end portion of a door of the entrance 5 appears in a captured image, including a passage floor around the entrance 5 and an area outside the bus through the door (see Fig. 3). An imaging section 2B at the exit 6 is installed in the same manner as the imaging section 2A at the entrance 5.

**[0023]** The processing section 3 is provided beside a driver seat and is composed of a computer or the like having software and a memory. As illustrated in Fig. 2, the processing section 3 includes a setting section 31, a person recognition section 32, a tracking section 33, a person area position data section 34, a count determination section 35, a door state recognition section 36, and a recording section 37.

**[0024]** The setting section 31 sets an inner area I and outer areas A, B so as to count a person appearing on the captured image. The inner area I and outer areas A, B are each a frame for capturing a moving position of a person at the platform (including a case where the platform is divided into an entrance and an exit). A shape and a size of each of the inner area I and outer areas A, B can be set according to conditions around the platform on the captured image. For example, as illustrated in Fig. 3, on the captured image of the entrance 5 or exit 6, the inner area I is set through the setting section 31 as a rectangular range surrounding a position corresponding to a passage inside the bus including the platform, and the outer areas A and B are set as a rectangular range surrounding the inner area I, wherein the outer area A corresponds to an area outside the bus, and outer area B corresponds to an area inside the bus. An area surrounded by an outer frame of the outer areas A and B may correspond to an imaging area (image capturing ar-

ea) of the imaging section 2. Further, the inner area I is set so as to include a unique point of a person existing at a portion near the entrance 5 or exit 6 inside the bus, the unique point being indicated by the person recognition section 32 to be described later. This allows a person staying on a floor inside the entrance 5 or exit 6 in the inner area I to be reliably recognized. The setting section 31 is operated through, e.g., a not illustrated operation terminal device connected to the processing section 3. In this case, the captured image of the entrance 5 or exit 6 is displayed on a display section of the operation terminal device, and an operator operates an input section such as a mouse or a keyboard while viewing the captured image displayed on the display section to thereby set the inner area I and outer areas A, B through the setting section 31.

**[0025]** The person recognition section 32 receives imaging data (captured image of the entrance 5 or exit 6) from the imaging section 2 and recognizes a person on the captured image corresponding to the imaging data. The person recognition can be carried out by various image processing methods, preferably, by an object image recognition method described in JP 3390426, JP 3406577, or JP 3406587. Roughly speaking, the object image recognition method performs person recognition as follows. That is, the method executes fundamental wave Fourier transform in a circular shape centering on each pixel point on the captured image to recognize an contour part of a moving person image which is a borderline between the person image and a background image and identifies, on the basis of the contour part, the person image with a unique point. According to the object image recognition method, it is possible to reliably recognize a person from the captured image obtained by a single camera and to perform image processing with a smaller amount of processing data and at a higher processing speed than in a differential imaging method.

**[0026]** The tracking section 33 recognizes a position of the unique point of each person recognized by the person recognition section 32 to track the person appearing on the captured image.

**[0027]** The person area position data section 34 issues a unique person ID for each person who is newly recognized by the person recognition section 32 on the captured image from the imaging section 2 and tracked by the tracking section 33 and creates area position data that records areas (area values of the inner area I and outer areas A, B inside and outside the bus) over which the recognized person moves. As illustrated in Fig. 4, the person ID is set as, e.g., a unique numerical value (see "sample value" in Fig. 4). The area position data includes data corresponding to an area (current area position T0) including a current position of a target person, data corresponding to an area (most recent area position T1) including a position immediately before the current position, and data corresponding to an area (past area position T2) including a position before the most recent area position T1. In each of the data (T0, T1, and T2), area

values (for example, A, I, B, etc., indicated as a "sample value" of Fig. 4) corresponding respectively to the inner area I, outer area A outside the bus, and outer area B inside the bus are recorded as a trace of the person who moves among the areas I, A, and B outside the bus.

**[0028]** The door state recognition section 36 receives an open/close signal of the door of each of the entrance 5 and exit 6, recognizes an open/close state of the door of each of the entrance 5 and exit 6, and inputs the recognized state to the count determination section 35. The open/close state of the door includes a state (door open state) where the door is fully opened and a state (door close state) where the door is fully closed, as well as, a time point when the opened door is fully closed, and a time point when the closed door is fully opened. As the open/close signal of the door, an external signal such as a door open/close operation signal to be generated by a door switch 4 (see Fig. 1) operated by a driver or a conductor of the bus or a door open/close detection signal of a sensor provided at an installation position of the door is used. In place of using the above external signal (operation signal, detection signal), the door state recognition section 36 may recognize the door open/close state by recognizing a motion of the door on the image captured by the imaging section 2. This makes it possible to omit the configuration for obtaining the external signal, thereby eliminating the need for wiring and connection work for taking in the external signal.

**[0029]** The count determination section 35 exchanges data with the person area position data section 34 and acquires the area position data of individual persons appearing on the captured image, while acquiring the open/close information of the door of entrance 5 and/or door of the exit 6, from the door state recognition section 36. On the basis of the above area position data and door open/close information, the count determination section 35 performs count processing of the number of passengers who get on the bus and/or the number of passengers who get off the bus. The count determination section 35 counts the number of persons who move from one outer area (A or B) to another outer area (A or B) through the inner area I during the door open state of the entrance 5 or exit 6, while not performing the count processing during the door close state. That is, at the entrance 5, while the door of the entrance 5 is opened, when it is recognized on the captured image of the entrance 5 that a person moves from the outer area A outside the bus to outer area B inside the bus through the inner area I, the count determination section 35 determines that the person has got on the bus and then performs the count processing to add 1 to the number of getting-on passengers; on the other hand, while the door of the entrance 5 is closed, even when there exists a person who moves among the outer areas A, B and inner area I, the count determination section 35 does not perform the count processing. Similarly, at the exit 6, while the door of the exit 6 is opened, when it is recognized on the captured image of the exit 6 that a person moves from the outer area B inside the

bus to outer area A outside the bus through the inner area I, the count determination section 35 determines that the person has got off the bus and then performs the count processing to add 1 to the number of getting-off passengers; on the other hand, while the door of the exit 6 is closed, even when there exists a person who moves among the outer areas A, B and inner area I, the count determination section 35 does not perform the count processing. As described above, the count determination section 35 does not perform the count processing during the door close state, so that even when a person moves around the entrance 5 or exit 6 while the door of the entrance 5 or exit 6 is closed, he or she is not erroneously counted in the number of getting-on or getting-off passengers.

**[0030]** Further, the count determination section 35 performs processing of determining a person existing in the inner area I at a time when the opened door is closed or the closed door is opened as a passenger to be counted. That is, at the entrance 5, a person staying in the inner area I on the captured image of the entrance 5 at a time when the opened door of the entrance 5 is closed is regarded as being moved to the outer area B inside the bus, and thus, he or she is regarded as being moved from the outer area A outside the bus to outer area B inside the bus through the inner area I and is counted in the number of getting-on passengers. Thus, even when a person stays around the entrance 5 due to congestion, he or she can be counted in the number of getting-on passengers. At the exit 6, a person staying in the inner area I on the captured image of the exit 6 at a time when the closed door of the exit 6 is opened is regarded as being moved from the outer area B inside the bus. Thus, when the person staying in the inner area I is moved to the exit 6 and gets off the bus, he or she is regarded as being moved from the outer area B inside the bus to outer area A outside the bus through the inner area I and is counted in the number of getting-off passengers. Thus, even when a person stays around the exit 6 while the door of the exit 6 is closed and count processing is not performed, he or she can be counted in the number of getting-off passengers. The counted person may be marked with a mark indicating "counted" to avoid the same person from being counted multiple times while he or she appears on the captured image. As described above, a person who actually gets on or off the bus but stays around the entrance 5 or exit 6 is also counted in the number of getting-on or getting-off passengers, so that it is possible to accurately count the number of passengers for each bus stop at which the door is opened/closed and for each getting-on or getting-off time.

**[0031]** The recording section 37 is composed of a storage unit such as an internal memory or an external memory and records therein the number of getting-on passengers and number of getting-off passengers counted by the count determination section 35. The recording section 37 can record therein the number of getting-on passengers and number of getting-off passengers every time

the door is opened/closed and for each bus stop (station) or bust stop number (station number) together with getting-on/off time, travel distance, and the like.

**[0032]** The following describes operation of the passenger counter 1.

**[0033]** In the passenger counter 1, an initial setting is performed by the setting section 31 to previously set the inner area I, outer area B inside the bus, and outer area A outside the bus on the captured image monitored by the imaging section 2.

**[0034]** First, the count processing to be performed at the entrance 5 will be described.

**[0035]** As illustrated in Fig. 5, when operation of counting the number of passengers is started, it is determined whether a new person appears on the image captured by the imaging section 2. When a new person appears on the captured image (S1), a unique person ID is issued for him or her, and the area position data associated with the person ID is newly created (S2). The area position data is constituted by the current area position T0, most recent area position T1, and past area position T2, and in each of the data, area values corresponding respectively to the inner area I, outer area A inside the bus, and outer area B outside the bus are recorded as a trace of the person who moves on the captured image.

**[0036]** Then, presence/absence of a person who moves among the outer areas A, B and inner area I on the captured image is detected (S3), and the area position data of the person who moves among the areas A, B, and I is updated (S4). The area position data is updated such that the most recent area position T1 is shifted to the past area position T2, the current area position T0 is to the most recent area position T1, and a current area value is recorded in the current area position T0.

**[0037]** Then, when the entrance 5 is in the open state, getting-on count determination is performed for the person whose area position data has been updated; on the other hand, when the entrance 5 is in the door close state, the getting-on count determination is not performed, and the processing flow is returned to step S1 (S5). The getting-on count determination is made based on whether or not the area position data of the person coincide with the area values corresponding to a getting-on direction (S6A). That is, when recorded data of the past area position T2, most recent area position T1, and current area position T0 of a person coincide respectably with A (outer area A outside the bus), I (inner area I), and B (outer area B inside the bus), he or she is determined to be a getting-on passenger. After being determined to be the getting-on passenger, the person is counted in the number of getting-on passengers, and a current count value is output (S7A) for storage in the memory. When the area position data of the person do not coincide with the area values corresponding to the getting-on direction, the processing flow is returned to step S1 ("No" in step S6A).

**[0038]** On the other hand, for the person determined not to move among the areas A, B, and I in step S3, it is determined whether or not the current area position T0

of the area position data indicates the inner area I (S8). When the current area position T0 does not indicate the inner area I, the processing flow is returned to step S1. The person whose current area position T0 indicates the inner area I is a person staying around the entrance 5 in the bus, and the area position data of him or her is edited (S10A) when the opened door is closed ("Yes" in S9A). The area position data is edited such that the most recent area position T1 is shifted to past area position T2, the current area position T0 is to most recent area position T1, and the area value indicating the outer area B inside the bus is written in the current area position T0. Thus, when the person staying at a portion around the entrance 5 inside the bus at a time when the opened door is closed is a person who gets on the bus when the door is opened, the area position data of him or her is such that the recorded data of the past area position T2, most recent area position T1, and current area position T0 indicate A (outer area A outside the bus), I (inner area I), and B (outer area B inside the bus), respectively. Then, the getting-on count determination is performed for the person whose area position data has thus been edited (S6A), and he or she is counted in the number of getting-on passengers, and a current count value is output (S7A) for storage in the memory. When the door has not yet been closed in step S9A, the area position data is not edited, and the processing flow is returned to step S1 ("No" in step S9A).

**[0039]** Next, the count processing to be performed at the exit 6 will be described.

**[0040]** As illustrated in Fig. 6, the count processing to be performed at the exit 6 differs from the count processing at the entrance 5 illustrated in Fig. 5 in that getting-off count determination is performed when the exit 6 is in the door open state (S6B, S7B) and processing for the person staying at a portion around the exit 6 inside the bus is performed (S9B, S10B).

**[0041]** In the getting-off count determination (S6B), when the recorded data of the past area position T2, most recent area position T1, and current area position T0 of a target person coincide respectably with B (outer area B inside the bus), I (inner area I), and A (outer area A outside the bus), he or she is determined to be a getting-off passenger. After being determined to be the getting-off passenger, the person is counted in the number of getting-off passengers, and a current count value is output (S7B) for storage in the memory.

**[0042]** For the person staying around the exit 6, the area position data of him or her is edited (S10B) at a time when the closed door is opened ("Yes" in S9B). The area position data is edited such that the area value indicating the outer area B inside the bus is written in the most recent area position T1. Thus, when the person staying around the exit 6 at a time when the closed door is opened is a person who has stayed at a portion around the exit 6 inside the bus since the door close state where the count processing is not performed, the area position data of him or her is such that the recorded data of the past

area position T2, most recent area position T1, and current area position T0 indicate none (initial value), B (outer area B inside the bus), and I (inner area I), respectively. Then, the processing flow is returned to step S1.

**[0043]** Then, when the exit 6 is opened, and the person staying around the exit 6 moves to the exit 6, the movement among the areas A, B, and I is detected, and the area position data is edited such that the recorded data of the past area position T2, most recent area position T1, current area position T0 are updated to B (outer area B inside the bus), I (inner area I), and A (outer area A outside the bus) (S4). Thus, even when the person who has already stayed at a portion around the exit 6 inside the bus at a time when the door is opened gets off the bus, he or she is determined to be the getting-off passenger by the above-described getting-off count determination (S6B) and counted in the number of the getting-off passengers (S7B).

**[0044]** Next, a case where the entrance 5 and exit 6 are integrated in one will be described. In this case, unlike of Fig. 1, the imaging section 2 is provided only at the one platform.

**[0045]** In this case, the getting-on count processing flow of Fig. 5 and getting-off count processing flow of Fig. 6 are combined. That is, as illustrated in Fig. 7, when the platform is in the door open state, the getting-on count determination (S6A) and getting-off count determination (S6B) are sequentially performed, irrespective of the order of which processing is processed first.

**[0046]** For the person staying at a portion around the platform inside the bus, editing of the area position data (S9A, S10A) at a time when the opened door is closed and editing of the area position data (S9B, S10B) at a time when the closed door is opened are performed, irrespective of the order of which processing is processed first. However, after the editing of the area position data (S10A) at a time when the opened door is closed is performed, the getting-on count determination (S6A) is performed.

**[0047]** When a person who has got on the bus from outside the bus stays at a portion around the platform inside the bus, the door is then inevitably closed, so that a situation in which the closed door is opened cannot occur for him or her. Thus, in the area position data of the person who stays at a portion around the platform inside the bus after getting on the bus, the processing (S9B, S10B) of writing the area value indicating the outer area B inside the bus in the most recent area position T1, which is to be performed at a time when the closed door is opened, is not performed. This prevents the person staying at a portion around the platform inside the bus after getting on the bus from being excluded from the count or from being erroneously counted in the number of getting-off passengers.

**[0048]** As described above, according to the passenger counter 1 of the present embodiment, the person staying around the entrance 5 or exit 6 after actually getting on the bus is properly counted in the number of pas-

sengers, so that it is possible to accurately count the number of passengers for each bus stop at which the door is opened/closed and for each getting-on or getting-off time.

**[0049]** Further, in the passenger counter 1 according to the present embodiment, the area position data is updated when the movement among the areas A, B, and I is detected, and the getting-on/getting off count determination is performed based on the order of the data contents of the area position data, thereby preventing error count or preventing the same person from being counted multiple times.

**[0050]** Further, even when the bus runs at night, where illumination for illuminating the platform is turned on in the door open state and turned off in the door close state, the number of getting-off passengers can be counted properly. That is, when the illumination for illuminating the platform is turned off in the bus running at night, a person recognized on the captured image becomes invisible, and the recognition and tracking processing are stopped. Then, when the door of the exit 6 is opened upon arrival of the bus at a bus stop, the illumination is turned on, and a person is recognized on the captured image. At this time, even when a getting-off passenger has been already in the inner area I, outer area B inside the bus is written (S9B, S10B in FIG. 6 or 7) in the most recent area position T1 of the area position data of him or her as described above. Then, when this person actually gets off the bus, he or she is counted in the number of getting-off passengers without fail (S6B, S7B in FIG. 6 or 7). Thus, the passenger counter 1 according to the present embodiment can accurately count the number of getting-off passengers of the bus at night.

## Claims

1. A passenger counter (1) that is adapted to count the number of persons who get on/off a vehicle, comprising:

an imaging unit (2) installed at an inside of the vehicle and adapted to capture a platform of the vehicle from an upper portion of the vehicle to obtain a captured image, and adapted to recognise/track a person appearing on the captured image;

a setting unit (31) configured to set, on the captured image, an inner area (I) which is an area corresponding to a passage inside the vehicle including the platform, and an outer area (A,B) surrounding the inner area (I), wherein the outer area is divided into an area A outside the vehicle and an area B inside the vehicle; and

a count determination unit (35) configured to count the number of persons who move from one outer area (A, B) to the other outer area (A, B) through the inner area (I) while a door of the

platform is opened, configured not to count the number of persons while the door is closed, and configured to perform processing of determining, as a person to be counted, a person existing in the inner area (I) at a time when the opened door is closed or the closed door is opened,

wherein

the count determination unit (35) is configured to count, as the number of getting-on passengers, the number of persons who move from the outer area A outside the vehicle to the outer area B inside the vehicle through the inner area (I) while the door is opened and is further configured to count, as the number of getting-on passengers, the number of persons who move from the outer area A outside the vehicle to the inner area (I) and then stay in the inner area (I) at a time when the opened door is closed and /or

wherein

the count determination unit (35) is configured to count, as the number of getting-off passengers, the number of persons who move from the outer area B inside the vehicle to the outer area A outside the vehicle through the inner area (I) while the door is opened and is further configured to count, as the number of getting-off passengers, the number of persons who stay in the inner area (I) at a time when the closed door is opened and then move from the inner area (I) to the outer area A outside the vehicle when the closed door is opened.

2. The passenger counter (1) according to claim 1, further comprising a door state recognition unit (36) configured to recognize a state of the door through a door open/close operation signal for opening/closing the door, a door open/close detection signal for directly detecting an open/close state of the door, or image recognition of a motion of the door on the captured image.
3. The passenger counter (1) according to any one of claims 1 to 2, further comprising:

a person recognition unit (32) configured to recognize a person on the captured image by identifying the person with a unique point; and a tracking unit (33) configured to track the unique point to track the person on the captured image, wherein

the setting unit (31) is configured to set the inner area (I) in a range including the unique point of the person on a passage of the platform inside the vehicle.

## Patentansprüche

1. Ein Fahrgastzähler (1), der dazu ausgelegt ist, die Anzahl der Personen zu zählen, die in ein Fahrzeug einsteigen/aussteigen, und der Folgendes umfasst:

eine bildgebende Einheit (2), die an einer Innenseite des Fahrzeugs installiert ist und dazu ausgelegt ist, eine Plattform des Fahrzeugs von einem oberen Abschnitt des Fahrzeugs aufzunehmen, um ein aufgenommenes Bild zu erhalten, und die dazu ausgelegt ist, eine Person zu erkennen/verfolgen, die auf dem aufgenommenen Bild erscheint;

eine Festlegungseinheit (31), die konfiguriert ist, um auf dem aufgenommenen Bild einen inneren Bereich (I) festzulegen, der einem Durchgang innerhalb des Fahrzeugs einschließlich der Plattform entspricht, und einen äußeren Bereich (A, B) festzulegen, der den inneren Bereich (I) umgibt, wobei der äußere Bereich in einen Bereich A außerhalb des Fahrzeugs und einen Bereich B innerhalb des Fahrzeugs unterteilt ist; eine Anzahlbestimmungseinheit (35), die konfiguriert ist, um die Anzahl der Personen zu zählen, die sich von einem äußeren Bereich (A, B) zu dem anderen äußeren Bereich (A, B) durch den inneren Bereich (I) hindurch bewegen, während eine Tür der Plattform geöffnet ist, die konfiguriert ist, um die Anzahl der Personen nicht zu zählen, während die Tür geschlossen ist, und die dazu konfiguriert ist, eine Verarbeitung vorzunehmen, die darin besteht, eine Person, die in dem inneren Bereich (I) zu einem Zeitpunkt vorhanden ist, wenn die geöffnete Tür geschlossen ist oder die geschlossene Tür geöffnet ist, als eine zu zählende Person zu bestimmen, wobei:

die Anzahlbestimmungseinheit (35) so konfiguriert ist, dass sie als die Anzahl der einsteigenden Passagiere die Anzahl der Personen zählt, die sich vom äußeren Bereich A außerhalb des Fahrzeugs zum äußeren Bereich B innerhalb des Fahrzeugs durch den inneren Bereich (I) bewegen, während die Tür geöffnet ist, und ferner so konfiguriert ist, dass sie als die Anzahl der einsteigenden Passagiere die Anzahl der Personen zählt, die sich vom äußeren Bereich A außerhalb des Fahrzeugs zum inneren Bereich (I) bewegen und dann im inneren Bereich (I) zu einem Zeitpunkt bleiben, wenn die geöffnete Tür geschlossen ist, und / oder wobei:

die Anzahlbestimmungseinheit (35) so konfiguriert ist, dass sie als die Anzahl der aussteigenden Passagiere die Anzahl der Personen zählt, die sich vom äußeren Bereich B innerhalb des Fahrzeugs zum äußeren Bereich A außerhalb



- des Fahrzeugs durch den inneren Bereich (I) bewegen, während die Tür geöffnet ist, und ferner so konfiguriert ist, dass sie als die Anzahl der aussteigenden Passagiere die Anzahl der Personen zählt, die sich im inneren Bereich (I) zu einem Zeitpunkt aufhalten, wenn die geschlossene Tür geöffnet wird, und sich dann vom inneren Bereich (I) zum äußeren Bereich A außerhalb des Fahrzeugs bewegen, wenn die geschlossene Tür geöffnet wird.
2. Der Fahrgastzähler (1) nach Anspruch 1, der ferner eine Türzustands-Erkennungseinheit (36) umfasst, die konfiguriert ist, um einen Zustand der Tür zu erkennen durch ein Türöffnungs-/Schließ-Betriebssignal zum Öffnen/Schließen der Tür, ein Türöffnungs-/Schließ-Erkennungssignal zum direkten Erkennen eines Öffnungs-/Schließzustands der Tür oder durch eine Bilderkennung einer Bewegung der Tür auf dem aufgenommenen Bild.
3. Der Fahrgastzähler (1) nach irgendetwem der Ansprüche von 1 bis 2, der ferner Folgendes umfasst:
- eine Personenerkennungseinheit (32), die so konfiguriert ist, dass sie eine Person auf dem aufgenommenen Bild erkennt, indem sie die Person mit einem eindeutigen Punkt identifiziert; und
- eine Nachführeinheit (33), die konfiguriert ist, um den eindeutigen Punkt zu verfolgen, um die Person auf dem aufgenommenen Bild zu verfolgen, wobei:
- die Festlegungseinheit (31) konfiguriert ist, um den inneren Bereich (I) in einem Bereich festzulegen, der den einzigartigen Punkt der Person auf einem Durchgang der Plattform ins Innere des Fahrzeugs einschließt.

## Revendications

1. Un compteur de passagers (1) qui est adapté pour compter le nombre de personnes qui montent dans un / descendent d'un véhicule, comprenant :
- une unité d'imagerie (2) installée à l'intérieur du véhicule et adaptée pour capturer une plate-forme du véhicule à partir d'une portion supérieure du véhicule afin d'obtenir une image capturée, et adaptée pour reconnaître / suivre une personne apparaissant sur l'image capturée ;
- une unité de définition (31) configurée pour définir, sur l'image capturée, une zone intérieure (I) qui est une zone correspondant à un passage à l'intérieur du véhicule incluant la plate-forme, et une zone extérieure (A, B) entourant la zone intérieure (1), sachant que la zone extérieure

est divisée en une zone A à l'extérieur du véhicule et une zone B à l'intérieur du véhicule ;

une unité de détermination de nombre (35) configurée pour compter le nombre de personnes qui se déplacent d'une zone extérieure (A, B) à l'autre zone extérieure (A, B) en passant par la zone intérieure (I) pendant qu'une porte de la plate-forme est ouverte, configurée pour ne pas compter le nombre de personnes pendant que la porte est fermée, et configurée pour effectuer un traitement consistant à définir, en tant que personne à compter, une personne existant dans la zone intérieure (I) au moment où la porte ouverte est fermée ou la porte fermée est ouverte,

sachant que :

l'unité de détermination de nombre (35) est configurée pour compter, en tant que nombre de passagers qui montent, le nombre de personnes qui se déplacent de la zone extérieure A, à l'extérieur du véhicule, vers la zone extérieure B, à l'intérieur du véhicule, en passant par la zone intérieure (I) pendant que la porte est ouverte, et qu'elle est en outre configurée pour compter, en tant que nombre de passagers qui montent, le nombre de personnes qui se déplacent de la zone extérieure A, à l'extérieur du véhicule, vers la zone intérieure (I) et restent ensuite dans la zone intérieure (I) à un moment où la porte ouverte est fermée et/ou

sachant que:

l'unité de détermination de nombre (35) est configurée pour compter, en tant que nombre de passagers qui descendent, le nombre de personnes qui se déplacent de la zone extérieure B, à l'intérieur du véhicule, vers la zone extérieure A, à l'extérieur du véhicule, en passant par la zone intérieure (I) pendant que la porte est ouverte, et qu'elle est en outre configurée pour compter, en tant que nombre de passagers qui descendent, le nombre de personnes qui restent dans la zone intérieure (I) à un moment où la porte fermée est ouverte et se déplacent ensuite de la zone intérieure (I) vers la zone extérieure A, à l'extérieur du véhicule, lorsque la porte fermée est ouverte.

2. Le compteur de passagers (1) d'après la revendication 1, comprenant en outre une unité de reconnaissance d'état de porte (36) configurée pour reconnaître un état de la porte à travers un signal d'opération d'ouverture/fermeture de porte pour ouvrir/fermer la porte, un signal de détection d'ouverture/fermeture de porte pour détecter directement un état d'ouverture/fermeture de la porte, ou la reconnaissance d'image d'un mouvement de la porte sur l'image capturée.

3. Le compteur de passagers (1) d'après une quelconque des revendications de 1 à 2, comprenant en outre :

une unité de reconnaissance de personne (32) 5  
configurée pour reconnaître une personne sur  
l'image capturée en identifiant la personne avec  
un point unique ; et  
une unité de poursuite (33) configurée pour  
poursuivre le point unique afin de suivre la per- 10  
sonne sur l'image capturée, sachant que :  
l'unité de définition (31) est configurée pour dé-  
finir la zone intérieure (I) dans une plage com-  
prenant le point unique de la personne sur un  
passage de la plate-forme à l'intérieur du véhi- 15  
cule.

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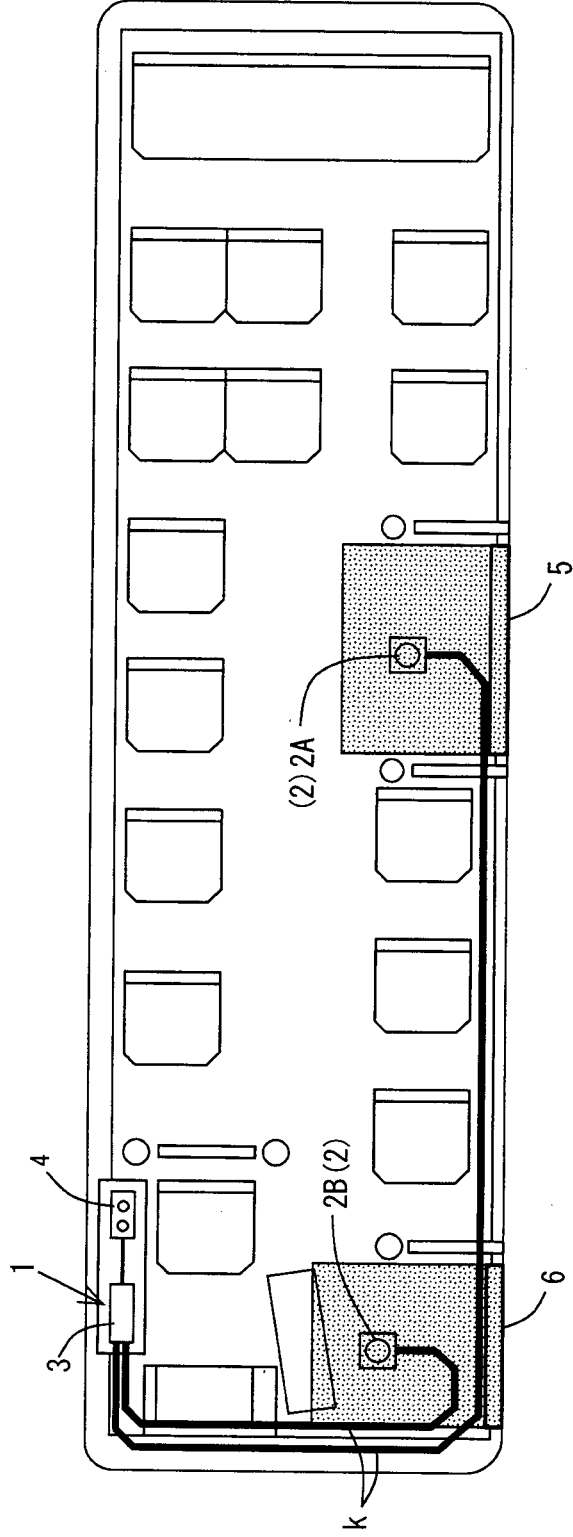


Fig. 1

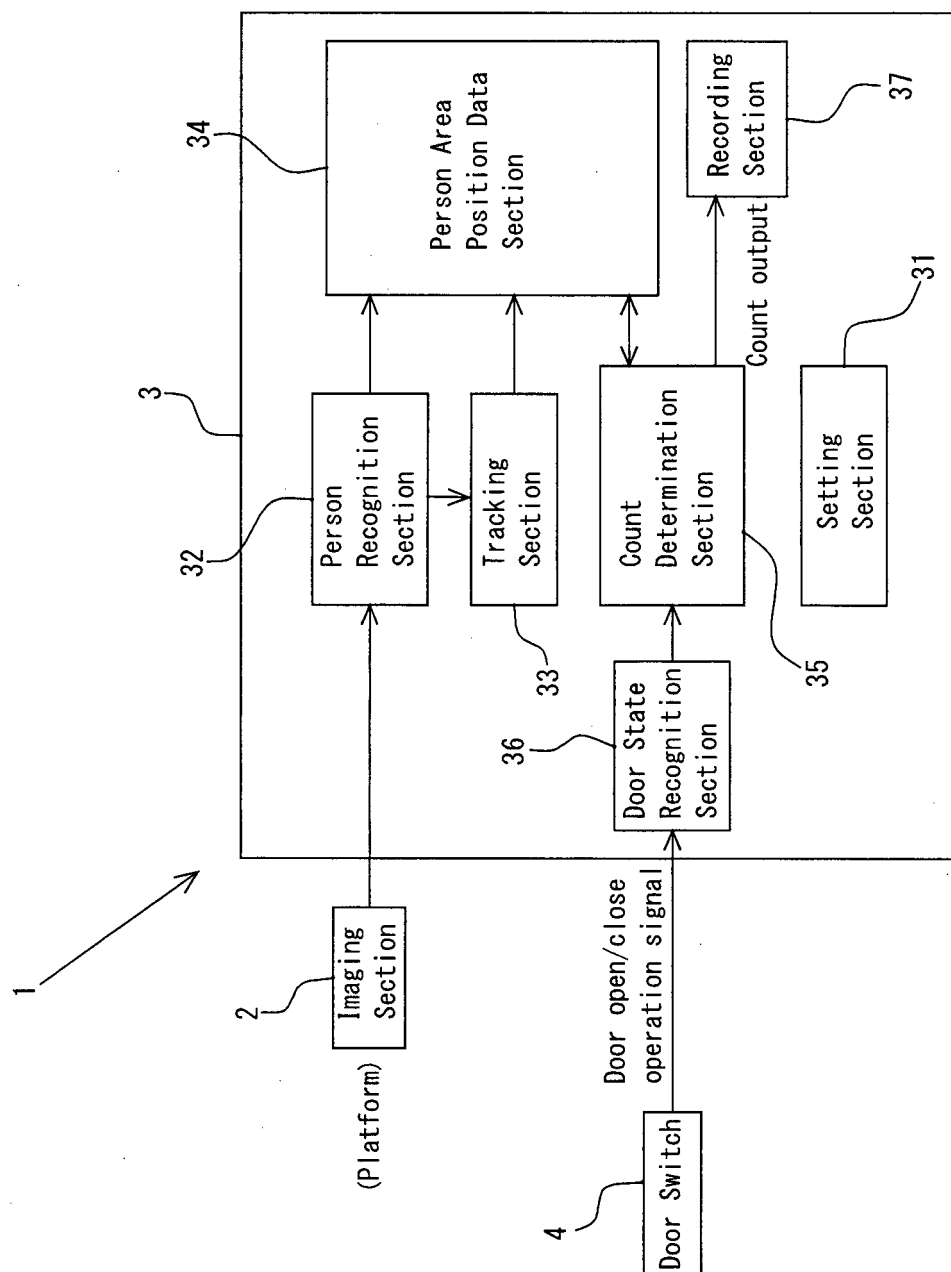


Fig. 2

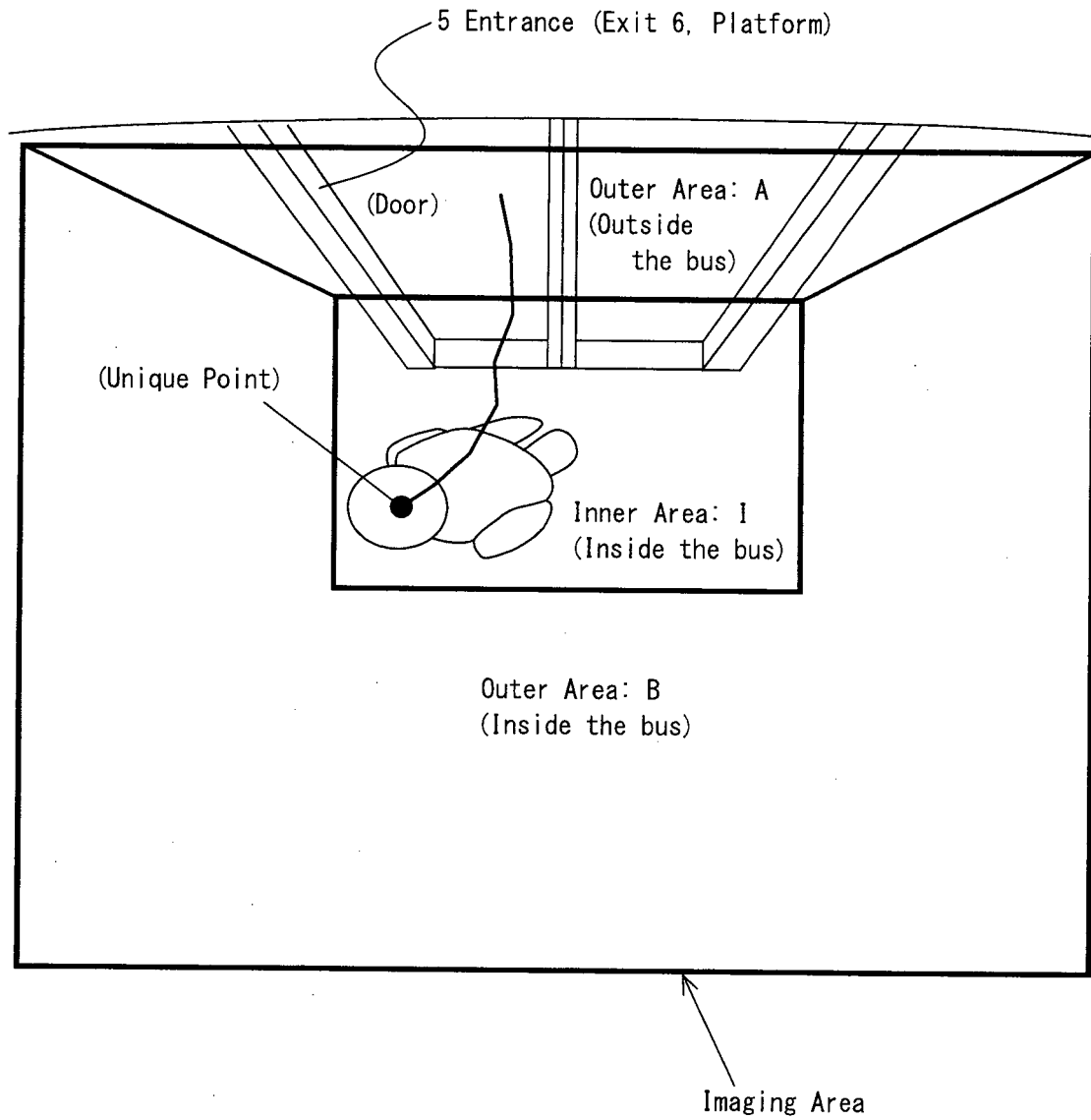


Fig. 3

Title		Sample Value											
Person ID		1	2	3	1	2	4	1	2	0	1	1	9
Area position data	Current area position T0 (an area including current position)	A			I			A			B		
	Most recent area position T1 (an area including a position before the current position)	I			B			I			NO (blank)		
	Past area position T2 (an area including a position before the most recent position)	B			NO (blank)			A			NO (blank)		

Fig. 4

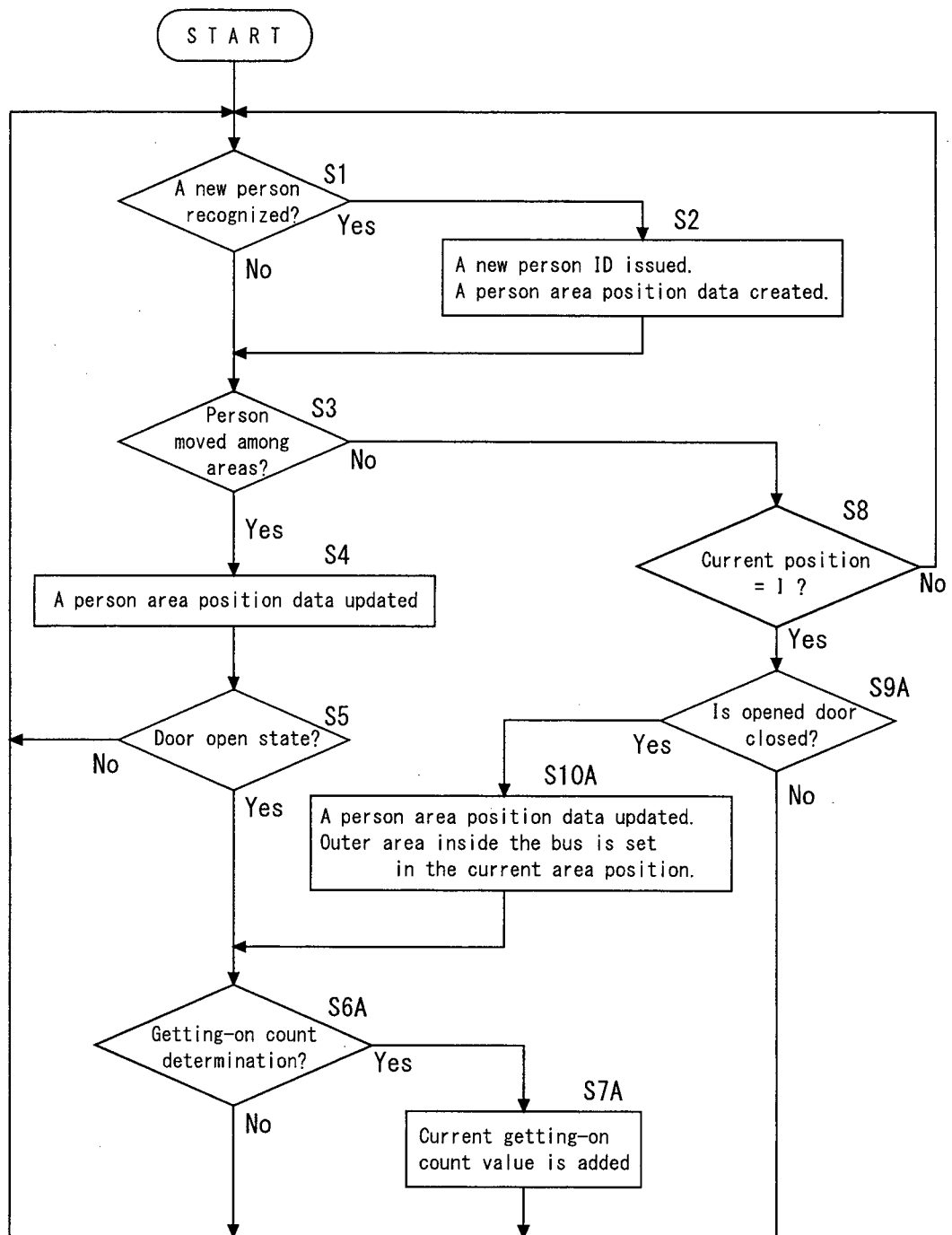


Fig. 5

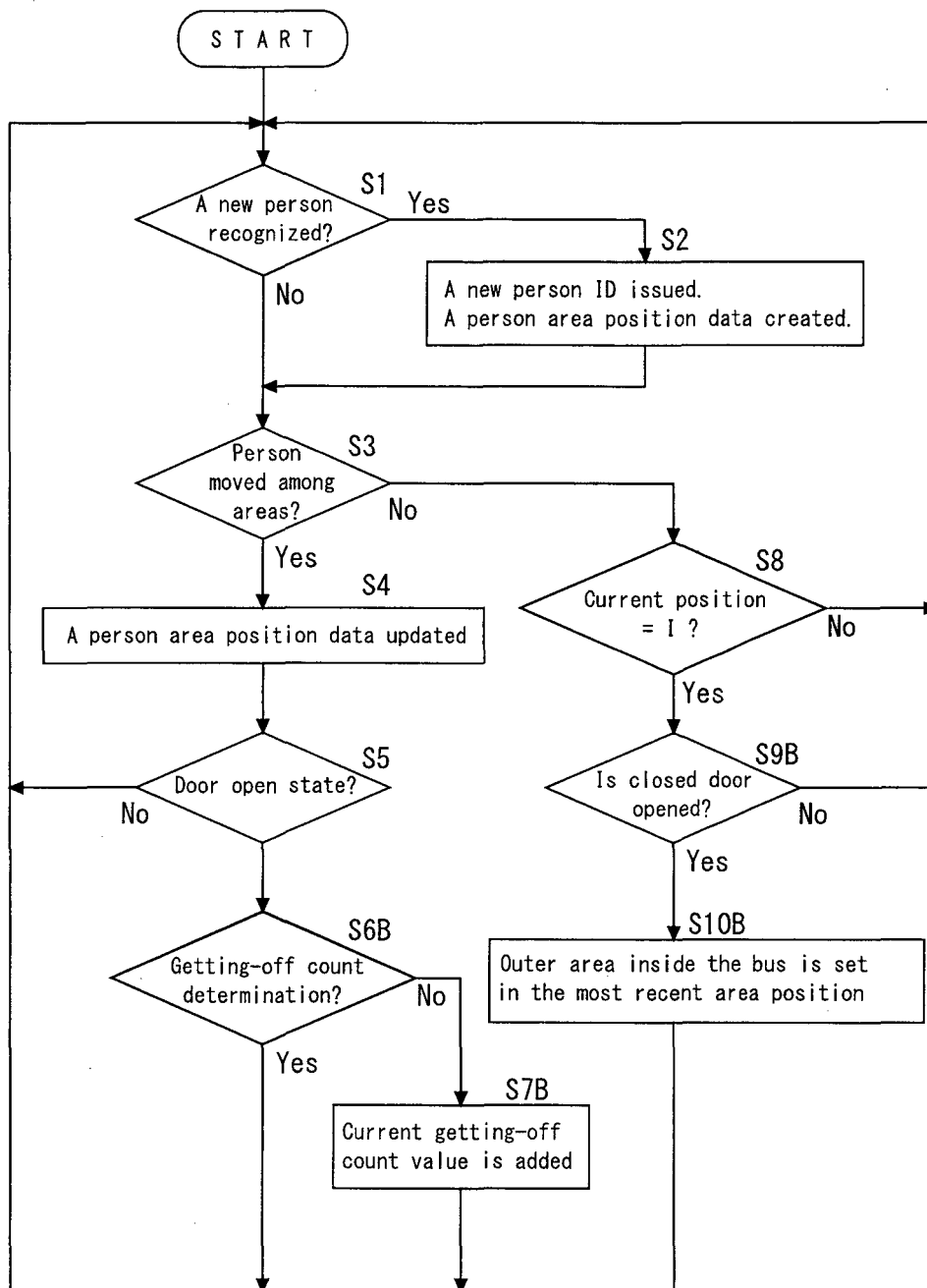


Fig. 6



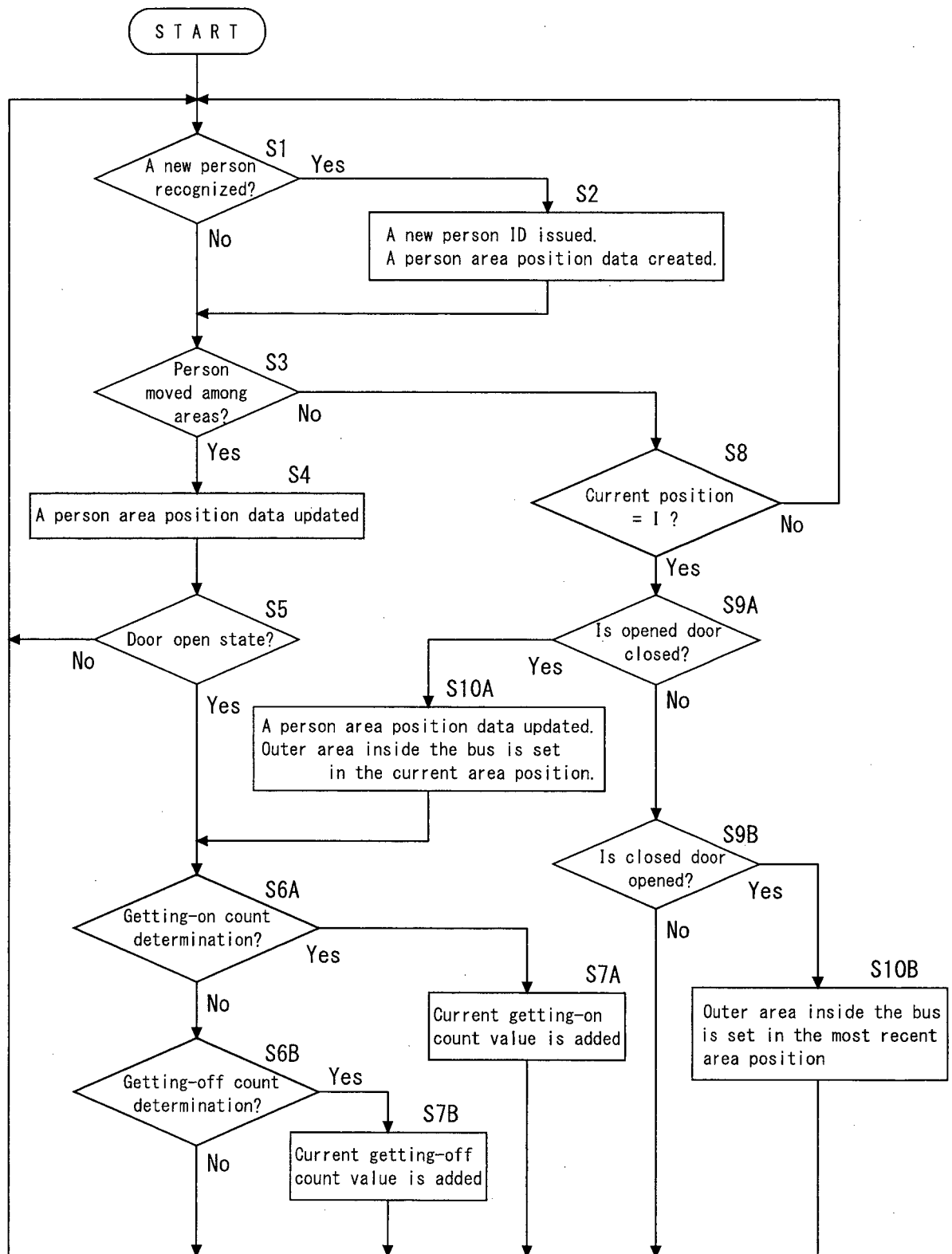


Fig. 7

**REFERENCES CITED IN THE DESCRIPTION**

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